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**GCSE**  
**COMBINED SCIENCE: TRILOGY**  
**8464/C/1H**

Chemistry Paper 1H

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**Mark scheme**

June 2021

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Version: 1.0 Final Mark Scheme



2 1 6 G 8 4 6 4 C 1 H / M S

Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students' responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students' scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Examiner.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students' reactions to a particular paper. Assumptions about future mark schemes on the basis of one year's document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from [aqa.org.uk](http://aqa.org.uk)

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## Information to Examiners

### 1. General

The mark scheme for each question shows:

- the marks available for each part of the question
- the total marks available for the question
- the typical answer or answers which are expected
- extra information to help the Examiner make his or her judgement
- the Assessment Objectives, level of demand and specification content that each question is intended to cover.

The extra information is aligned to the appropriate answer in the left-hand part of the mark scheme and should only be applied to that item in the mark scheme.

At the beginning of a part of a question a reminder may be given, for example: where consequential marking needs to be considered in a calculation; or the answer may be on the diagram or at a different place on the script.

In general the right-hand side of the mark scheme is there to provide those extra details which confuse the main part of the mark scheme yet may be helpful in ensuring that marking is straightforward and consistent.

### 2. Emboldening and underlining

- 2.1** In a list of acceptable answers where more than one mark is available ‘any **two** from’ is used, with the number of marks emboldened. Each of the following bullet points is a potential mark.
- 2.2** A bold **and** is used to indicate that both parts of the answer are required to award the mark.
- 2.3** Alternative answers acceptable for a mark are indicated by the use of **or**. Different terms in the mark scheme are shown by a / ; eg allow smooth / free movement.
- 2.4** Any wording that is underlined is essential for the marking point to be awarded.

### 3. Marking points

#### 3.1 Marking of lists

This applies to questions requiring a set number of responses, but for which students have provided extra responses. The general principle to be followed in such a situation is that 'right + wrong = wrong'.

Each error / contradiction negates each correct response. So, if the number of error / contradictions equals or exceeds the number of marks available for the question, no marks can be awarded.

However, responses considered to be neutral (indicated as \* in example 1) are not penalised.

Example 1: What is the pH of an acidic solution?

[1 mark]

Student	Response	Marks awarded
1	green, 5	0
2	red*, 5	1
3	red*, 8	0

Example 2: Name two planets in the solar system.

[2 marks]

Student	Response	Marks awarded
1	Neptune, Mars, Moon	1
2	Neptune, Sun, Mars, Moon	0

#### 3.2 Use of chemical symbols / formulae

If a student writes a chemical symbol / formula instead of a required chemical name, full credit can be given if the symbol / formula is correct and if, in the context of the question, such action is appropriate.

#### 3.3 Marking procedure for calculations

Marks should be awarded for each stage of the calculation completed correctly, as students are instructed to show their working. Full marks can, however, be given for a correct numerical answer, without any working shown.

#### 3.4 Interpretation of 'it'

Answers using the word 'it' should be given credit only if it is clear that the 'it' refers to the correct subject.

### 3.5 Errors carried forward

Any error in the answers to a structured question should be penalised once only.

Papers should be constructed in such a way that the number of times errors can be carried forward is kept to a minimum. Allowances for errors carried forward are most likely to be restricted to calculation questions and should be shown by the abbreviation ecf in the marking scheme.

### 3.6 Phonetic spelling

The phonetic spelling of correct scientific terminology should be credited **unless** there is a possible confusion with another technical term.

### 3.7 Brackets

(.....) are used to indicate information which is not essential for the mark to be awarded but is included to help the examiner identify the sense of the answer required.

### 3.8 Allow

In the mark scheme additional information, 'allow' is used to indicate creditworthy alternative answers.

### 3.9 Ignore

Ignore is used when the information given is irrelevant to the question or not enough to gain the marking point. Any further correct amplification could gain the marking point.

### 3.10 Do **not** accept

Do **not** accept means that this is a wrong answer which, even if the correct answer is given as well, will still mean that the mark is not awarded.

## 4. Level of response marking instructions

Extended response questions are marked on level of response mark schemes.

- Level of response mark schemes are broken down into levels, each of which has a descriptor.
- The descriptor for the level shows the average performance for the level.
- There are two marks in each level.

Before you apply the mark scheme to a student's answer, read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

### **Step 1: Determine a level**

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student's answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer.

When assigning a level you should look at the overall quality of the answer. Do **not** look to penalise small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level.

Use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 2 with a small amount of level 3 material it would be placed in level 2 but be awarded a mark near the top of the level because of the level 3 content.

### **Step 2: Determine a mark**

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this.

The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student's answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner's mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do **not** have to cover all of the points mentioned in the indicative content to reach the highest level of the mark scheme.

You should ignore any irrelevant points made. However, full marks can be awarded only if there are no incorrect statements that contradict a correct response.

An answer which contains nothing of relevance to the question must be awarded no marks.

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.1	(Group) 0 or noble gases		1	AO2 5.1.2.2
01.2	B		1	AO2 5.1.1.3
01.3	A		1	AO3 5.1.1.3
01.4	(atoms with the) same number of protons	allow atoms with the same atomic number  allow atoms of the same element  ignore the same number of electrons	1	AO1 5.1.1.5
	(but with) different numbers of neutrons	ignore (but with) different mass numbers  do <b>not</b> accept (but with) different relative atomic mass	1	
01.5	$\frac{(39 \times 93.1) + (41 \times 6.9)}{100}$ = 39.138 = 39.1	allow correctly rounded answer to 1 decimal place from an incorrect calculation using all the values given in the question	1	AO2 5.1.1.6
			1	
			1	
<b>Total</b>			<b>8</b>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	green to red		1	AO1 5.4.2.4
02.2	decreases		1	AO1 5.4.2.4
02.3	(aq)	allow aq  ignore aqueous  ignore HNO <sub>3</sub>	1	AO1 5.2.2.2
02.4	any <b>two</b> from: <ul style="list-style-type: none"> <li>• (white) solid disappears</li> <li>• fizzing / bubbles / effervescence</li> <li>• (then) stops fizzing</li> <li>• (white) solid left at the end / bottom</li> </ul>	allow a gas is produced          ignore colourless solution	2	AO3 5.4.2.2 5.4.2.3
02.5	Zn(NO <sub>3</sub> ) <sub>2</sub>		1	AO2 5.1.1.1 5.4.2.2



Question	Answers	Mark	AO / Spec. Ref.
<b>02.6</b>	<b>Level 3:</b> The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.	5–6	AO1 5.4.2.2 5.4.2.3 RPA8
	<b>Level 2:</b> The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.	3–4	
	<b>Level 1:</b> The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	
	<b>No relevant content</b>	0	
	<b>Indicative Content:</b> <ul style="list-style-type: none"> <li>• react hydrochloric acid</li> <li>• (with) copper oxide</li> <li>• in a suitable container</li> <li>• warm (hydrochloric) acid</li> <li>• add copper oxide</li> <li>• until is in excess  <b>or</b>                      until solid remains</li> <li>• stir</li> <li>• filter excess copper oxide</li> <li>• pour solution / filtrate into evaporating basin</li> <li>• use of water bath  <b>or</b>                      use of electric heater</li> <li>• to heat gently  <b>or</b>                      partially evaporate</li> <li>• leave to cool / crystallise</li> </ul> For level 3 the correct chemicals must have been selected.		
<b>Total</b>		<b>12</b>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	temperature (of solution)	allow temperature change	1	AO1 5.5.1.1
03.2	any <b>three</b> from: <ul style="list-style-type: none"> <li>• insulate the beaker <b>or</b> use polystyrene cup</li> <li>• add a lid</li> <li>• stir more (times)</li> <li>• repeat the experiment <b>and</b> calculate the mean (ignoring anomalous results)</li> <li>• use smaller volume (of water)</li> <li>• use larger mass of ammonium nitrate</li> <li>• more accurate balance</li> <li>• use digital thermometer <b>or</b> use a more accurate thermometer</li> </ul>		3	AO3 5.5.1.1
03.3	(from 0 to 1.5 minutes the) temperature decreases  (because) ammonium nitrate dissolving is endothermic  (then) after 1.5 minutes the temperature increases  (because) energy transfers to the solution from the surroundings	allow the temperature decreases (from 21.4 °C to 15.4 °C)  (then) after 15.4 °C the temperature increases	1  1  1  1	AO3 5.5.1.1

<b>03.4</b>	labelled horizontal lines for reactants and products, with the product line below the level of the reactant line		1	AO1 5.5.1.2
	reaction pathway	allow curve to start / finish anywhere along reactant / product lines	1	
	line from reactants to maximum labelled activation energy		1	
	line from reactants to products labelled overall energy change		1	
the diagram below scores 4 marks				
<b>Total</b>			<b>12</b>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	C <sub>60</sub>		1	AO1 5.2.3.3
04.2	(graphite has) delocalised electrons		1	AO1 5.2.3.2
	(so the delocalised electrons) carry electrical charge through the structure	allow (so the delocalised electrons) move through the structure	1	
04.3	carbon atoms have different sizes to iron atoms / ions		1	AO1 5.2.2.7
	(so carbon atoms) distort the layers of iron atoms / ions		1	
	(therefore) the layers cannot slide		1	
04.4	(percentage and mass of other elements) 28.08 (%) = 16.29 (g)		1	AO2 5.2.2.7
	(mass of fork) = $\frac{16.29}{28.08} \times 100$ (g)		1	
	= 58.01 (g)		1	
	(mass of iron = $\frac{71.92}{100} \times 58.01$ ) = 41.72 (g)	allow (mass of fork – mass of other elements) = 41.72 (g)  allow 41.7 (g)  allow correct use of incorrect calculation of mass and / or percentages	1	
<b>Total</b>			<b>10</b>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	reduction	ignore electrolysis	1	AO2
	(as H <sup>+</sup> ions) gain electrons		1	AO1 5.4.1.4 5.4.3.1 5.4.3.4 RPA 9
05.2	$2\text{Cl}^- \rightarrow \text{Cl}_2 + 2\text{e}^-$	allow $2\text{Cl}^- - 2\text{e}^- \rightarrow \text{Cl}_2$ ignore state symbols allow <b>1</b> mark for $\text{Cl}_2 + \text{e}^-$ allow <b>1</b> mark for $- \text{e}^-$ (on lhs) <b>and</b> $\text{Cl}_2$ (on rhs)	2	AO2 5.4.1.4 5.4.3.1 5.4.3.4 RPA9
05.3	water molecules	allow dissociate to produce OH <sup>-</sup> ions ignore discharged ignore oxygen is produced as no halide is present	1	AO1 5.4.1.4 5.4.3.1 5.4.3.4 5.4.3.5 RPA9
	break down to produce OH <sup>-</sup> ions		1	
	(which are) attracted to the positive electrode		1	
	(where OH <sup>-</sup> ions are) oxidised <b>or</b> (where OH <sup>-</sup> ions) lose electrons		1	
<b>Total</b>			<b>8</b>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
<b>06.1</b>	(mass of oxygen = 0.20 – 0.12) = 0.08 (g)	} allow 1 mark for 0.005 if derived from $\frac{0.08}{16}$	1	AO2 5.1.1.1 5.3.1.1 5.3.1.3 5.3.2.1 5.4.1.1
	(moles of oxygen) = $\frac{0.08}{32}$		1	
	= 0.0025		1	
<b>06.2</b>	(without a lid the) mass of magnesium oxide was less	allow magnesium oxide escaped	1	AO3 5.4.1.1
	(because) products escaped		1	
<b>06.3</b>	(mass of copper oxide =)	allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses all the values in the question	1  1  1	AO2 5.1.1.1 5.3.1.1 5.3.1.3 5.3.2.1 5.3.2.2 5.3.2.3 5.4.1.1
	$\frac{79.5}{63.5} \times 0.5$			
	= 0.62598 (g)			
	= 0.626 (g)			

<b>06.4</b>	3:2 ratio Fe : O <sub>2</sub> (molecules) <b>or</b> 3:4 ratio Fe : O (atoms)  (formula) Fe <sub>3</sub> O <sub>4</sub>  $3\text{Fe} + 2\text{O}_2 \rightarrow \text{Fe}_3\text{O}_4$	allow <b>1</b> mark for Fe <sub>3</sub> O <sub>2</sub> from 3:2 ratio Fe : O (atoms) (MP2 but not MP1)  allow multiples  allow correct use of incorrectly determined formula  allow <b>1</b> mark for Fe, O <sub>2</sub> and Fe <sub>3</sub> O <sub>4</sub> <b>or</b> allow <b>1</b> mark for Fe, O <sub>2</sub> and incorrectly determined formula	1   1   2	AO2 5.1.1.1 5.3.1.1 5.3.1.3 5.3.2.1 5.3.2.2 5.3.2.3 5.4.1.1
<b>Total</b>			<b>12</b>	

Question	Answers	Extra information	Mark	AO / Spec. Ref.
<b>07.1</b>	particles collide		1	AO3 5.5.1.2
	(but at room temperature) particles have insufficient energy <b>or</b> (but) have energy less than the activation energy (so collisions are not successful)		1	
<b>07.2</b>	2120 (kJ/mol)		1	AO3 5.5.1.2 5.5.1.3
<b>07.3</b>	(bonds broken = $(8 \times 410) + 2 \mathbf{X} + (5 \times 500)$ $= 5780 + 2 \mathbf{X}$	allow C–C for <b>X</b>	1	AO2 5.5.1.3
	(bonds formed = $(6 \times 740) + (8 \times 460)$ $= 8120$	allow (bonds broken = $(8 \times 410) + (5 \times 500)$ $= 5780$		
	(bonds broken – bonds formed = energy released) $(5780 + 2 \mathbf{X}) - 8120 = -1640$	allow correct use of incorrect values from step 1 and/or step 2		
	$(2 \mathbf{X} =) 700$	allow correct use of incorrect value from step 3		
	$(\mathbf{X} =) 350$ (kJ/mol)			
<b>Total</b>			<b>8</b>	